Coastal Transport Information System (Co.Tr.I.S.): System and Subsystems Description

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Abstract. Co.Tr.I.S is a multifunction information system that will be used for the effective design of coastal transportation lines. Co.Tr.I.S incorporates six subsystems (S1-S6) which include models, tools and techniques that may support the design of improved coastal networks. A major contribution expected by Co.Tr.I.S is to support the decision making process of the policy makers and the involved players (Ministry, Maritime companies, Local Authorities), towards an improved Coastal Transport System. In order to support this functionality, Co.Tr.I.S is equipped with subsystems for data retrieval (S1, S2), statistical analysis (S3), data visualization (S4), as well as subsystems with specialized modules for network generation, scenario validation (S5), solution optimization and decision support (S6). All these subsystems can have access to the vast amount of the up-to-date data classified and modeled by Co.Tr.I.S, and therefore, the system user (coastal line designer or decision maker) will benefit from the improved representation and the improved solution proposals offered by Co.Tr.I.S. The aim of this paper is to present the Co.Tr.I.S subsystems with emphasis to subsystems S5 & S6.

Keywords: Coastal transport · Modeling · Optimization

1 Introduction

Coastal transportations lines may affect not only the development of a coastal city in many ways but also the development of an entire country. Especially in a country like Greece which is considered an important maritime crossroad with more than 400 inhabited islands, the formation of urban networks and city-hierarchies under the conditions of economic globalization and European integration, is strongly affected by the coastal transportation network.

Although a lot of models for road / land transport networks exist, only very few proposals for the coastal transport (e.g. motorways of the sea, EC; Wright and Bartlett, 2000) or multi-modal transport networks are mentioned in the literature (Xie, 2009). Given the lack of literature and similar systems, the main innovation of this system is

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that it gives integrated solutions to the coastal design networks. Co.Tr.I.S uses original and multi-parametric tools which incorporates spatial, statistical analysis, cartographical visualization, games theory and modified the salesman problem. C.o.Tr.I.S. is developed in the frame of a research project co-funded by the European Union and the Greek Government. This system could be used in any island environment taking into account topics like geography, fleet composition, volume of traffic, network design, port infrastructure, and other system parameters (Pantazis et. al, 2013). Co.Tr.I.S. includes six major subsystems (see Fig. 1): S1: Subsystem for information retrieval and queries from DBs, S2: Subsystem for information retrieval from relative sites, S3: Subsystem for statistical treatment and forecasting scenarios, S4: Subsystem for thematic mapping and graphic representations, S5: Subsystem for new lines design, line modifications, what-if scenarios and cost/benefit calculations, S6: Subsystem for decision support using optimization & games theory techniques.

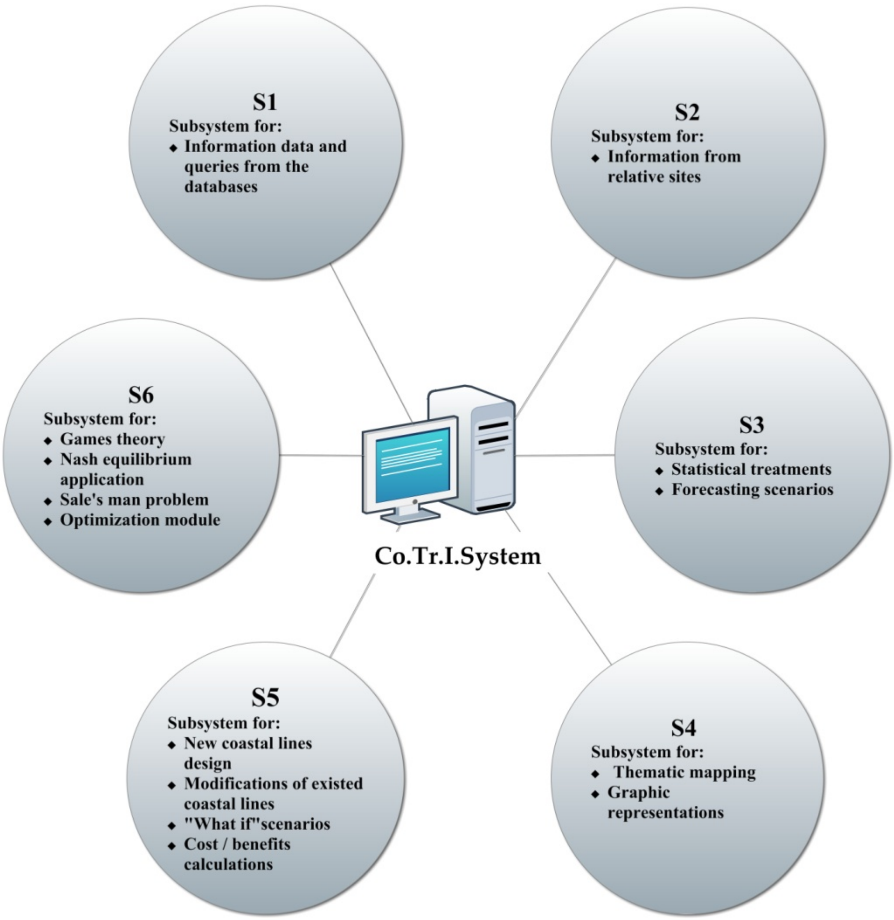

Fig. 1. Co.Tr.I.S. subsystems (*Source:* Moussas et al., 2015)

This paper presents all Co.Tr.I.S. subsystems with special focus on subsystems S5 and S6. The next section presents the overall Co.Tr.I.S. System, sections three to nine present the Co.Tr.I.S. subsystems S1 to S6 respectively, section ten analyze the Optimization module with reference to the optimization tools, and the last section presents future steps and research perspectives.

2 System Description

Co.Tr.I.S. is based on a Geographic Information System (GIS) software, adds-on traffic management and other (mapping, statistics, design) applications and it is divided in six different subsystems (Fig. 1). The system design was based on MECOSIG method (Pantazis & Donnay, 1996). The system's functionality combines network (vector) analysis, spatial analysis of raster surfaces (e.g. representing the cost), game and graph theory including Nash equilibrium and the salesman problem (Pantazis et al., 2013). Coastal transport network is stored in a geodatabase using a custom transportation data model. The system user requirements are met by the system's functions using the necessary data (Fig. 2).

Fig. 2. Co.Tr.I.S. requirements data and functions

The system's users are divided into five different categories (groups). Each group will use a slightly different version of the application that is adjustable (data & functions) to their needs (Fig. 3).

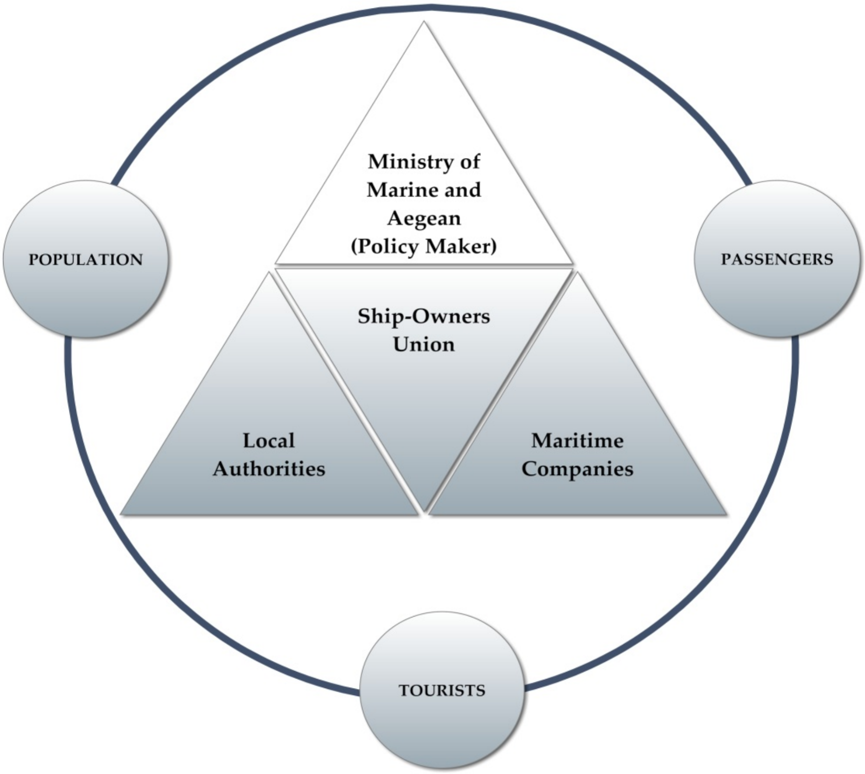

Fig. 3. Co.Tr.I.S. potential users

The potential Co.Tr.I.S users are: Local Authorities, Ship-owners union, Coastal lines companies, Ministry of Marine and Aegean (Policy makers) and Passengers. For the moment we focus in the three major potential users which are: Local Authorities, Coastal lines companies, Ministry of Marine and Aegean (Policy makers).

3 Subsystem S1: Information Data and Queries from Co.Tr.I.S. Databases

Subsystem S1 hosts the information data collected by Co.Tr.I.S and stored in the system's database. Subsystem S1 provides extended editing capabilities and a user friendly interface to facilitate the queries into the system. Some examples of supported queries (see Fig. 4) are the following (Pantazis et. al, 2013): Which are currently the coastal lines?, Which are the ports that had a specific number of passengers (set by the user) disembarked last year?, Which are the coastal lines (or itineraries) that start from e.g. Piraeus and have a ticket fare less than e.g. 40 euros?, Which are the coastal lines (or itineraries) that have Paros as an intermediate port (or destination or final destination)?, Which are the coastal lines (or itineraries) that have Chania as destination (or intermediate port or final destination)?

The system has extended capabilities concerning the automatic generation of reports and the display of summarized numerical tables with integration or not of schemas or maps. These modules are mainly designated to the local authorities, helping them to create proposals for new costal lines including a preliminary cost-benefits analysis. S1 also includes the functions of databases updating.

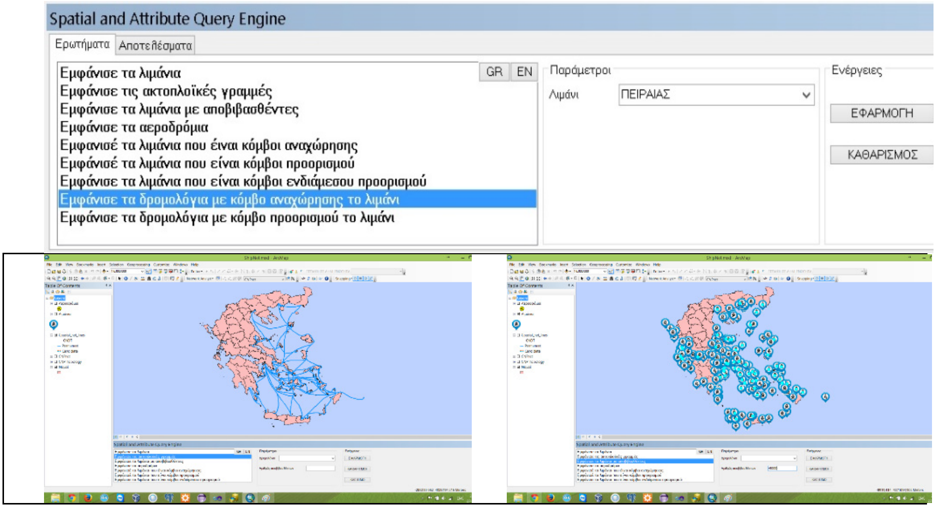

Fig. 4. Spatial and Attribute Query Engine of Co.Tr.I.S.

4 Subsystem S2: Information from Relative Sites

Information concerning the marine traffic and the Vessel positions tracking based on Automatic Identification System (AIS) data are available in the Co.Tr.I.S interface. Data concerning the available itineraries between islands or ports in general, the ships available, the coastal lines between specific ports and fare prices are also available via the system's connection with the relative sites (i.e. www.petas.gr web site). S2 functions give an additional control of the stored information facilitating the error identification and the future proposals creation (for new coastal lines).

5 Subsystem S3: Statistical Treatments, Forecasting Scenarios

Co.Tr.I.S. has capabilities for monitoring, evaluating and analyzing coastal transport lines and the relative infrastructure facilities (e.g. ports), and supports: a) strategic queries (e.g. given a number of passengers at a specific line, how many itineraries could simultaneously operate in a week base?), and, b) operational tasks (e.g. how many and what kind of ships can simultaneously arrive to a port?), based on a number of statistical results and data which are integrated into the system. The system uses statistical analysis results for an effective decision making during the process of new costal lines design. Data concerning the Greek coastal transport network have been organized, analyzed and interpreted through statistical processes.

For statistical purposes, after the collection and the initial classification of the data, the following assumption has been made: The numerical data correspond only to the disembarked passengers (residents/visitors) per each port, and not to those who have embarked on the same ship of the same line at the same time. There is no any significant quantitative difference between these two categories. The applied statistical treatments are: -Calculation of central tendency measures (arithmetic mean, median) and variation measures as well (standard deviation, minimum, maximum, range), for disembarkations per each year and season, -Calculation of percentage change between the three years per quarter, shipping line and port, in order to have comparable results between the same intervals of different years where data are available, -Creation of linear graphic charts presenting the coastal traffic of disembarked passengers per quarter, shipping line and port, -Creation of diagrams showing distributions of passengers per quarter, shipping line and port. The statistical treatments are performed with Statistical Package for Social Science (S.P.S.S.) and with Microsoft Excel. The integration of statistical process in ArcGIS platform is under development. Co.T.Ri.S. will be able to produce reports, charts and statistical treatment, e.g the total distribution of passengers per year and per port (see Fig. 5).

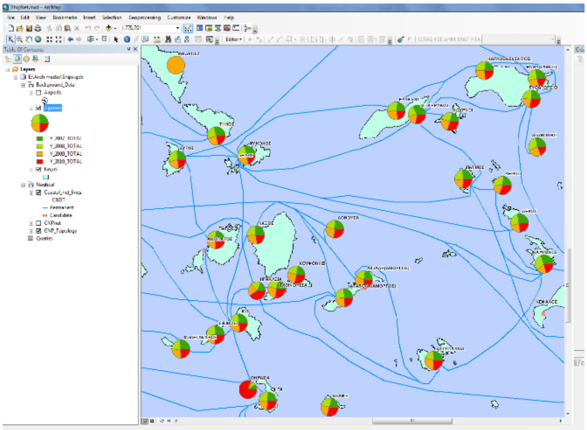

Fig. 5. Statistical treatment and graphic representation by Co.T.Ri.S

6 Subsystem S4: Thematic Mapping, Graphic Representations

Co.Tr.I.S. gives the possibility of various maps creation and visualization such as: a) digital and paper maps representing e.g. the coastal lines, the ports and the types of ships (with photos), b) thematic maps based on the islands and coastal lines characteristics such as: island populations, island tourists/passengers number, frequency of ship itineraries, etc., and, c) animated maps. The most important question to answer for the development of the subsystem S4 was: what kind of maps are necessary to improve the costal lines design? The visualization of all the spatial entities related with the system (ports, hubs/nodes, coastal lines) may be realized in classic (with topographic background) and schematic (thematic) maps helping the decision making.

This section presents the thematic maps created by Co.Tr.I.S.. The cartographic representation helps to understand the current situation in costal transport network and reviles its weaknesses. This information is used by the system in order to identify potential connections which are missing and support the process for new lines proposals in the costal network. The spatial data used for the thematic maps are the following: a) Coastline from the Organization of Cadastre of Greece (data type: line), b) Administrative boundaries of municipalities of Greece according to the last reform of the Ministry of Interior called "Kallicrates"(data type: polygon), c) Location of the ports in Greece (data type: point), d) Location of the airports in Greece (data type: point), e) Location of the hospitals and health centers (data type: point).

The creation of the coastlines were based on a map of the Hellenic Military Geographical Service (HMGS), 1:100.000 scale, which was scanned at a high resolution and georeferenced at the Greek Geodetic Reference System (EGSA 87). The coastlines were also verified with data from the Ministry of Maritime and the Aegean. Passenger's number in each line and each port, provided by the Hellenic Statistical Authority (EL.STAT.), were joined with the above mentioned spatial data in order to be used for map creation.

There are three different categories of maps created based on the main spatial data type. The first refers to the polygon data type where the attributes have a different color graduation according to the population number. The second refers to the point data type where there is a different symbol size based according to the number of the passengers at each port. The third category of the maps refers to the schematic representation of the costal lines. There are 23 thematic maps that have been created in order to describe the current situation of the coastal transport traffic network.

Co.Tr.I.S. provides a specific interface to the user, in order to permit the on-the-fly creation of those thematic maps. This means that the user will be able to create spatial and attribute queries regarding the coastal network, and the system will respond with the resulting map satisfying the query. These queries are kept in a separate table and each one of them has an SQL statement assigned to it. The parameters of the SQL statement are managed via the ArcMap interface.

7 Subsystem S5: New Coastal Lines Design, Modification of Existing Coastal Lines, What if Scenarios, Cost/Benefit Calculations

Subsystem S5 handles the main Co.Tr.I.S. functions: creation and /or modification of coastal lines. The system's user may create new costal lines or generally interact with the network in order to determine whether a new connection between ports is needed to be created or deleted or altered and modified. The system substantially supports the decision making process concerning the costal transportation issues, eg.: • Must be removed a specific costal line? Why? How? When? • Must be changed an existing coastal line? • Must be created a new costal line? • How is it possible to reduce the cost of a specific coastal line? (Pantazis et al, 2013).

The new coastal lines creation or modifications may be realized manually (manual generation) or semi automatically or automatically. In the first case the user chooses the ports involved in the itinerary directly from the geographic interface in order to create the new coastal line (the system will provide all the relative information stored in the databases), in the second case the user chooses the ports from a popup menu and in the third case the system may suggest new lines, having specific characteristics and according to selected rules, that will be displayed in digital maps. Based on these rules the system could also generate all coastal lines connections that are relevant.

8 Subsystem S6: Decision Support with Games Theory, Nash Equilibrium Application, Sales Men Problem

The coastal transport problem in the Aegean Sea is very complex and multivariable. It can be generally described with the classic problem of salesman. Given a collection of (a) cities/ports/ harbors etc. and (b) the cost of travel between each pair of them, the travelling salesman problem (TSP) is to find the cheapest way of visiting all the cities and return to the starting point. In the standard version of the problem, the travel costs are symmetric in the sense that travelling from port X to port Y costs just as much as travelling from Y to X. In our case a) the latter does not apply, b) the salesman does not wish to visit all the customers, c) the salesman visits some customers only in specific periods through the year, d) the salesman needs different transportation means to reach every customer, e) the salesman agrees to visit some customers if they pay a specific price, f) exists many salesman g) some salesmen wish to collaborate with other salesmen or wish not etc. (Pantazis et al., 2013)

Elements of Game theory can be also used and integrated in our conceptual framework. Traditional applications of game theory attempt to find equilibriums in these games. In equilibrium, each player of the game has adopted a strategy that they are unlikely to change.

The Subsystem S6 is addressing to the coastal lines companies in order to help them in the strategic choices of coastal lines design and creation. It is also addressing to the ship-owners union in order to avoid unnecessary conflicts if possible. This module is not yet completely developed. For example it is still under investigation the fact that Nash equilibrium application may lead to “cartel” situations. S6 and S5 are the main subsystems for Decision Support and they are, in turn, supported by a set of tools including: simulators, route generators, cost evaluators, and optimizers as described in the next section.

9 Optimization in Co.Tr.I.S Subsystems S5 and S6

A major contribution expected by Co.Tr.I.S is to support the decision making process of the policy makers and the involved players (Ministry, Maritime companies, Local Authorities), towards an improved Coastal Transport System in the area. In order to support this functionality, Co.Tr.I.S subsystems S5 & S6 include several specialized modules for network generation, scenario validation, solution optimization and decision support. All these modules will have access to the vast amount of data classified and modeled by Co.Tr.I.S and therefore, will offer globally improved solution proposals.

The size and complexity of the entire Aegean costal transport system prohibit any manual or interactive search for better or optimal solutions. The overall Coastal Transport System complexity increases exponentially with the number of lines, destinations and realistic parameters included, and any typical enumeration or Branch and Bound method would require an unacceptable long time to reach an optimal solution. As a result, a tool using Evolutionary Methods was needed to provide optimization support on user demand and provide a ranked list according to the user's requirements and priorities of the best alternative scenarios.

During the last decades, many researchers studied the complex problem of the Aegean Sea coastal transport system. Several methods for coastal transport optimization and simulation have been proposed in the literature, but they usually tackle only a small part or a reduced version of the entire problem (Chainas 2012, Giziakis et al. 2006, Darzentas and Spyrou, 1996). Works on coastal network optimization demonstrated the promising use of evolutionary/heuristic techniques when applied to solve the container ship fleet problems such as cost, consumption, distance and deadlines (Karlafatis et al., 2009, Sun and Li, 2006), the hub positioning problem the liner shipping problem (Tsilingiris and Psaraftis, 2006, Khaled Al-Hamad et at. 2012) or, to consider environmental issues (Windek, 2013). Evolutionary techniques were also successfully combined with methods from Graph theory or Game theory especially in a search of equilibrium for network design with competing goals (Dinu and Odagescu, 2011, Fagerholt, 2004).

The Co.Tr.I.S user is usually a decision maker trying to find the solution/scenario that will best satisfy several competing goals such as: cost, consumption, user satisfaction, etc. Co.Tr.I.S database (ArcGIS) offers all kinds of current and past information about the Aegean Sea transport system, such as: connection lines, ships, schedules, geographical & thematic maps, passenger & vehicle demand, prices, etc.

These multifold and detailed data and their numerous alternative values, create a huge solution space that contains many potential coastal transport scenarios. By using Co.Tr.I.S the decision maker is supported by the decision/optimization modules to come up with a proposal containing a ranked set of the best solutions. The use of Co.Tr.I.S framework accelerates the entire procedure and the search concludes in a fraction of the time usually required.

9.1 Modeling for the Co.Tr.I.S. Optimization Tools

The detailed information on the Aegean Sea coastal transport offered by Co.Tr.I.S, the realistic and complex relationships employed, and, the many and contradicting goals create a Non-deterministic Polynomial (NP-hard) optimization problem that cannot always be solved within acceptable computer time by the exact algorithms. Therefore, in Co.Tr.I.S the optimization module is based on heuristics/evolutionary techniques i.e. the Genetic Algorithms that are more suitable, they search only a part of the vast solution space and converge faster to or near the optimal solution.

Optimization Methodology

The problem of Coastal Transport System can be seen as a multi-level or multi-stage problem consisting of several interconnected stages such as: 1) The Geometry of the network with all the nodes (ports) and their connections. At this stage we define the mainland ports, the potential hub ports, principal and secondary connections, fixed connections set by the state, forbidden connections due to safety or environmental issues, redundant connections for reliability, and alternative connection combinations. At this stage constrains and goals may include the overall distance, the total number or the reliability of the connections. 2) The Routes serviced. The routes & trips as well as the sequence of ports per trip are defined here. Different types of routes like shuttle trips, circles, or hub & spoke structures can be selected. At this stage constrains and goals may include the number of ports per trip, the allowed deviation, the overall distance, capacity of ports concerning the type of ships, etc. 3) The Schedule and Frequency of Service. The frequency of service is defined by the Routes and their corresponding demand. This stage is highly dependent on the previous stage 2 decisions and at the same time its results may lead to a route rearrangement, in order to cover demand. Other goals may include min frequency per destination, reduction of bottlenecks, min connection delays, etc. 4) The Ship Allocation. For each route/schedule defined in 2&3 the company must assign a ship with the appropriate characteristics of type, speed, capacity The overall Fleet deployment must satisfy constrains and goals such as max demand coverage, max ship utilization, min ship cost, ports posed by the maritime companies. 5) Operational issues. This stage is based on the results of 3 & 4. Ship operation issues like speed, port queues, and time windows for arrival/departure or load/unload are defined here, and the results may lead to a ship reallocation at 4 or re-scheduling at stage 3.

The optimization tools in Co.Tr.I.S will be able to face either single stage or multi-stage problems. When facing a simple network problem or when the optimization focuses in one of the above stages, the use of a simple optimization technique is usually sufficient to provide the required solution. But, the typical problems that Co.Tr.I.S user (decision maker) is about to face will cover almost all five stages of the large and complex Aegean Sea coastal network, thus, resulting to a multi-level hierarchical system. In this case a bi-level optimization may be required where by using game theory techniques equilibrium is reached (e.g. Stackelberg, Nash).

By taking in to account all possible variations in each of the aforementioned five stages, the resulting alternative scenario combinations create a huge solution space that can be efficiently searched only by an evolutionary technique. The optimization tool employed is based on the Genetic Algorithm method. An Input Processing/Validation module validates all user inputs and collects any required information from the Arc-GIS database, a Scenario Generation module creates valid routes & scenario solutions, a Scenario Evaluation module evaluates the scenario performance based on selected performance indices, and the GA Optimization module implements the GA algorithm until convergence is reached (Moussas et. al, 2015).

Evolutionary methods and GAs represent each member of the population by a chromosome. In our case this chromosome is created by the variables set by the user and the ranged variables retrieved from the database. The entire set of these variables will create the search space for the optimal scenario. Any unfeasible solutions or constrain violations are either discarded or they receive a higher penalty based on a quadratic function.

Coastal System Modeling for Optimization

In order to achieve globally optimal solutions and search flexibility, the system model contains a large number of coastal transportation parameters and variables. All together they build a set of Measured Values (MV) of our system. From the full set of MVs another set of Calculated Values (CV) is also produced. Altogether MVs and CVs create a phenotype a system solution/scenario. Phenotype contents are then combined to form the Performance Indices (PI) for each scenario. Finally, all the PIs are combined to a single KPI (Key Performance Index). The KPI corresponds to the overall score of the fitness function of the optimization algorithm. There is no unique KPI, as it is a weighted sum of all PIs and the corresponding weights are not fixed but they are defined by the user (KPI_u).

$$KPI_u = \sum_{k=1}^{n} w_{u/k} \cdot PI_k$$

Each user may have a separate set of weights W_u that best represent is user objectives and goals. Currently four different KPIs have been designed, corresponding to three different actors i.e., the ministry, the maritime companies and the local authorities. An indicative list of the model variables (MV, CV, PI & KPI), is presented in the following Table 1.

For a typical user request many of the above quantities will be fixed (constant value), others will be free to change inside an acceptable range (discrete or continuous) and the rest of them will be set/adjusted/restricted by the user. The non-fixed variables will create the GA chromosome that defines the search space that contains all the alternative solutions (scenarios).

Table 1. Indicative List of tUhe Problem (Scenario) Model Variables

Measured Values (MVs)	**Calculated Values (CVs)**
Island characteristics per Island (population, autonomy, hospitals and public services, airports, local population transportation demand, visitors demand, etc.)	Calculated from the available MVs Per Implemented Route: - travel time, - delays - over-length - productivity, - reliability - demand coverage - fleet capacity coverage, - cost, - income, etc.
Port characteristics - per Port (capacity constrain for ships – size and number, infra-structure for refueling, waste, passenger accommodation, load/unload delays, .etc.)	
Connections-All possible combinations (geographical distance, nautical distance, shuttle line or cyclic route, forced route, number of stops, alternative routes, etc.)	
Demand - per Route (passengers, cars, trucks, seasonality, etc.)	
Fleet – per Ship (type, capacity, speed, various costs, various fares, etc.)	
Schedule (frequency of each route, depar-ture, travel time, delays, time windows, bad weather delays, winter/ summer adjust-ments, waiting queues, etc.)	
Demand statistics and Forecasts, Weather statistics, etc.	

Scenario Performance Indices (PIs)
Total travelling distance Total delay, Total cost, Total revenues, Total demand coverage, Total fleet coverage, Coverage of local demand Coverage of state demands,

Scenario Key Performance Indices (KPIs)
Per User preferences/goals: $KPI_u = \sum_{k=1}^{n} w_{u/k} \cdot PI_k$

In addition to the model variables & parameters a large number of constrains is always imposed to the designer and/or decision maker. For the coastal transport system under development, an indicative list of constrains follows: available fleet (set of available ships) and shipping companies, min/max capacity per route (required/permitted), min/max speed per route (required/permitted), min wind speed (for delays, for cancelation), max over-length (final route length over direct connection), max time per route (sum of travel+delays time allowed to complete a trip), max number of stops (number of intermediate ports), min allowed frequency of service (required number of trips per week), aver/max load/unload delay (acceptable delays per port/stop), aver/max waiting for connection line (waiting time in a hub port), max number of hubs, min demand coverage, min capacity coverage, etc. The example in the following section demonstrates the functionality of Co.Tr.I.S decision support and its optimization modules.

9.2 Sample Scenario Selection

A sample of the Aegean islands was selected to demonstrate the basic workflow during the optimization & decision making phase that is supported by the Co.Tr.I.S tools. The sample contains 6 ports: the mainland port and 5 islands in the Cyclades, Greece area: Syros, Paros, Naxos, Mykonos, Amorgos.

The data are retrieved from the database and they contain the required information such as: the distances between all ports, the passenger demands from one port to the other, etc., mainly in a form of symmetric matrices. Distance, demand and infrastructure information is used to classify and select the ports more suitable to act as hubs (the mainland port is always a hub). For each hub setup, all possible port combinations are detected and classified as: mainland lines, hub lines or local lines. For the 6 ports of the above example, and by considering the use of up to 3 hubs, a total of 523 different permutations was found, creating a large pool of routes from where, each scenario should select the ones to implement.

A first optimization step is applied to reduce the number of routes, by selecting the optimal one between permutations of the same combination. The Shortest Path optimization is used to select the shortest route servicing the same set of ports, leading to the best 106 port combinations. A classification step is then applied to further reduce the number of routes by removing the less efficient ones. The efficiency of each route is calculated as a function of its demand, distance, time number of stops and other characteristics. The less efficient routes to ports that are already serviced by more efficient ones can be discarded, thus reducing the available lines to 59 or: a) 23 using 1 hub, b) 20 using 2 hubs, or, c) 16 using 3 hubs. These numbers are still large as they can create hundreds & thousands of scenarios to implement for just 6 islands.

From the available set of routes, hundreds or thousands of valid scenarios can are created. In this optimization step, a Genetic Algorithm is implemented to cope with the huge number of alternative in a more manageable way. The GA population is consisted of different implementation scenarios. Each scenario will contain a number of routes in order to serve the 6 ports. For each scenario, the network implementation is represented by a chromosome containing 1s and 0s indicating if a route of the set is included or not in the scenario (Fig. 6). The GA starts with an initial population of randomly generated scenarios, and, after a number of generations concludes to a ranked list of the best individuals survived.

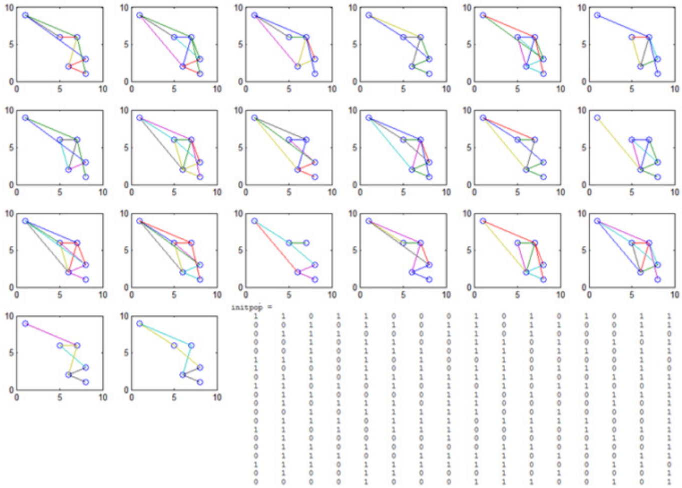

Fig. 6. The GA's random initial population of scenarios (networks) and their chromosomes

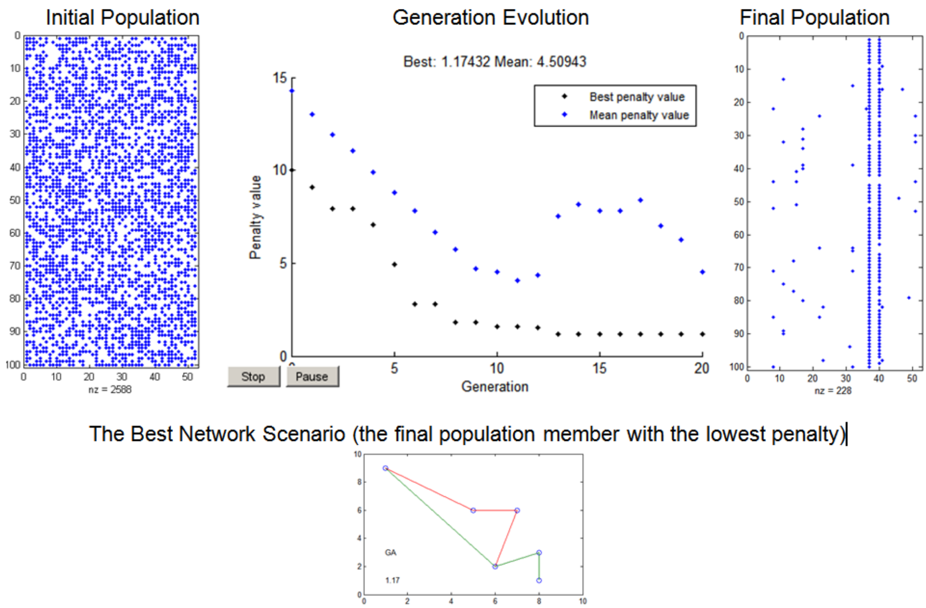

Fig. 7. The GA's result (lower), its convergence after 20 generations (up-middle), the chromosomes of the random initial (left) and the last (right) generation.

The fitness function calculates the overall efficiency of each scenario and the members of each generation are classified and reproduced according to their score. In this demo sample the overall score of a scenario is a function of the number and the efficiency of the implemented routes, their redundancy and of any penalty due to missing connections. The scenario heaving the highest score when convergence is met, it is considered as the best or optimal (Fig. 7).

The above described scheme demonstrates only the workflow towards the selection of an optimal Aegean Sea coastal Network scenario. It is not the complete solution of the problem as, another complementing part with chromosomes representing the traffic of the network (ships & schedules) is also under development. Depending on the case under consideration and the user selections, the two Genetic Algorithms will function either separately in sequence (first network then traffic) or in collaboration as the Bi-level optimization scheme described in section 9.

10 Future Steps and Research Perspectives

A presentation of the system will be realized in the next months to the three categories of the potential users. The under-development system presentation will include both "power point" presentation of the system's functions and the operational use of the system prototype. Views and critical analysis on the proposed system from the potential users are expected in order to improve the functions and complete its role and functionality. The main role of the system for each potential user, will determine the final crucial functions of the system for each user, which currently are: a) for the Ministry, the existence of coastal transport lines during the whole year for all islands, b) for the local authorities, the possibility of new proposals development concerning new coastal lines, c) for the maritime companies, the "discovery" of new profitable costal lines.

The system presentation will provide a feedback with proposed changes in order to improve the functionality of the system. Data, spatial database, system's rules, system's interface, system's functions, etc. will be modified if necessary. We also consider and analyze the system's contribution in the event of a natural disaster by developing the following functions and databases: Information about the number and type of ships which can arrive at the same time in a port, Information about the airports and choppers fields, Information about the time / distance of the nearest hospital / health center for each island. Automatic production of useful maps representing: location of schools, hospitals, area of natural disaster, etc. with possibility of crowd sourcing mapping capabilities. The module is under development.

An important number of islands lack health infrastructure like medical centers, clinics or hospitals. Many islands have not any doctor or dentist. In serious diseases or accidents it is necessary to transfer the patient by helicopter or ship or special boats rented by the state for this purpose. The Co.Tr.I.S. will provide the necessary information for the location (ports) of the special boats for patient transport, permitting a better and overall management of their fleet.

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